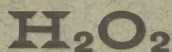


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HYDROGEN PEROXIDE.*

BY WM. B. CLARKE, M.D.,

Indianapolis, Ind.

Gentlemen of the Institute: I wish to call your attention to an agent of remarkable power, having peculiar interest by virtue of its varied utility, and which has been too long in the obscurity from which it now seems to be emerging, only hoping that its vast, dimly foreshadowed possibilities may soon be fully realized. Hydrogen peroxide was discovered in 1818, by Thénard, a French chemist, and introduced to the medical profession in 1858 by that indefatigable physiological experimenter, Dr. B. W. Richardson. Passing over the rather difficult chemistry of its production (which may be found in Dr. Mitchell's article in MEDICAL ERA, in the U. S. Disp., and in works on chemistry), it is enough for the purposes of this article to merely state that it is liquid oxygen, since the pure article gives off 475 volumes of oxygen. According to the investigations and testimony of many eminent French and German writers, chemists and physicians, *it is the most powerful anti-putrid application known*, and withal, intelligently used, is as bland as water. All micro-organisms are controlled by it, and it instantly arrests the process of fermentation in all its forms. Prof. P. Miguel, as the result of his experiments, places it at the head of a long list of bactericides, judging from its power of arresting fermentation. (His table of figures may be found in Leonard's little handbook on diagnosis, bacteria chapter, but does not include bichloride of mercury or nitrate of silver.) It is a powerful bleaching agent, being most used on bones, ivory, silk, feathers and hair. The modern "bleached blonde" appearance of that so-called

* Read at the Indiana Institute of Homœopathy May 19, 1885, published in the MEDICAL ERA July 1885, and republished in response to numerous requests, after having been revised by the author at our request.

“crowning glory of woman,” so much admired by some, and detested by others, is obtained by the use of this agent, usually sold as the great French blonde producer, at a dollar an ounce. Freckles, Sepia spots and other chromatoses may be removed by it. It converts drying oils into non-drying oils, renovates old oil paintings, and is used by photographers. It is a delicate test for chromium and its salts, and also for blood, pus or chyle in the urine. **It is unsurpassed as a dressing for pus-discharging surfaces**, especially in cases otherwise difficult of access, for the instant hydrogen peroxide touches pus, effervescence takes place, and continues until the pus is destroyed. I often liken the appearance to that produced by the familiar culinary operation of whipping eggs. The contents of that historical, present or future pus-pocket, probed with this searching agent, would, unmindful of the law of gravitation, stand not upon the order of going, but seem only anxious to get out, and boil out, at once.* Irritable surfaces are soothed by it and soon develop healthy granulations, and, in otherwise desperate cases, septicæmia and pyæmia are easily averted. Purulent ophthalmia, ophthalmia neonatorum, suppurative otitis media, **gonorrhœa and leucorrhœa, yield rapidly to its curative influence.** It is useful in many cases of ulcerated os uteri (mixed with glycerine and applied on absorbent cotton and left *in situ* a few hours). It is also useful as a mouth-wash or gargle for daily use (properly neutralized), or in dental abscess, caries, coated tongue, stomatitis, tonsillitis, diphtheria, or laryngeal phthisis; in ozæna (after removing the crusts), and especially in syphilitic, exzematous or varicose ulcers, and old sores and wounds, epithelioma, or carbuncles, having decided curative and soothing as well as cleansing properties in all cases.

Gen. Grant's throat trouble should have been treated, in part at least, with hydrogen peroxide, and Gen. Hancock's carbuncle should have been treated with it.

Its somewhat anæsthetic action is due, I suppose, to the rapid involvement and absorption of oxygen going on.

It would be useful in that terribly offensive condition of the breath that ensues when the secretion of the tonsils becomes cheesy, granular—inspissated, as it were. It is

* Specimens of pus and ozæna clinkers were here shown and the destroying effect of hydrogen peroxide upon them demonstrated.

my conviction that most cases of foul breath come from this often-overlooked cause.

It will prove useful for washing out the stomach or bladder when indicated, especially the latter, as it effervesces and destroys those bladder irritants and obstruents, chyle, pus and blood. The pleural cavity would easily be cleaned by it in a case of empyema, and so would the mastoid cells after an operation, psoas, lumbar, hepatic or burrowing abscesses and buboes.

It ought to be useful by inhalation in cases of croup, dyspnœa, whooping cough, and eminently so in the terrible suffocation spells of valvular deficiency.

I always depend upon it in the first part of a dressing for wounds that are healing, then wipe dry with a fine sponge or absorbent cotton, and follow with calendula cerate in which iodoform has been rubbed up. This is a treatment hard to beat.

In France it has been used by Pean as a spray in ovariectomy.

In the language of C. E. Shelly (*Practitioner*, March, 1884): "I recommend the use of this agent, which I know to possess powerful antiseptic properties, and, moreover, is colorless, odorless, cleansing and stimulating, does not stain or corrode, destroys pus, causes no pain in its application, and is not poisonous"; to which I would add, and is healing.

The *MEDICAL ERA* for May, 1885, has an item to the effect that Massei, Leci and Boucher agree in praising the efficacy of inhalations of oxygen in diphtheria, as being a poison to bacteria and a stimulant to the adynamia and threatened paralysis of the pneumogastric.

I append a recent clipping of interest in this connection: "*La Nature* prints a communication from the Brin Brothers, French chemists, in which they state that they now have in operation an apparatus that produces 100 cubic metres of oxygen a day. This gas is made directly from atmospheric air, a desideratum long aimed at by chemists, and can be produced in large quantities at a low price. The applications of oxygen are likely to be very many. It is thought to be superior to carbonic acid gas for aerated beverages, is of great value in metallurgy and has antiseptic properties."

In this connection it may be well to say that the popular and mildly exhilarating beverage in the principal

Parisian hotels and restaurants now is distilled water strongly charged with pure oxygen gas, and this at the suggestion of Dujardin-Beaumetz.

In the April *Medical World* an article headed, "Italy's Atmosphere" and the Voice," reads as follows: "The mellowness and compass of voice enjoyed by the natives of Italy are ascribed to the presence of much hydrogen peroxide in the dew and air of their country. It is supposed to improve the quality and *timbre* of the voice, and has been shown to produce this effect elsewhere, artificially, by the inhalation of a chemical compound made to imitate an Italian atmosphere."

For "Sanitas," the most popular English disinfecting powder, which I have used satisfactorily, the claim is made: "This powder is non-poisonous, evolves sanitas into the atmosphere and generates peroxide of hydrogen."

In February, 1885, Dr. Bettman, in a paper read before the Chicago Medical Society, stated that he had had good results from the peroxide in thirty cases of purulent otitis media. It could be injected directly into the middle ear and caused no pain, but destroyed pus and bacteria, and dislodged decomposing material. Five cases of dacryocystitis had yielded to it after positive failure with the routine treatment with astringents, carbolic acid, Bowman probes, gelatine bougies, etc., and a case of chronic trachoma responded well to it. Under the microscope he found that pus corpuscles irrigated with it at once lost their spherical form, shrank, assumed a concentric shape, and became heaped up as a mass of detritus, and in a few seconds the bacilli were transformed into a dead mass, mingled with decomposed pus corpuscles, and surrounded with seething bubbles of gas.

In the *New York Medical Journal*, April 25, 1885, is a paper on hydrogen peroxide, by Dr. Dayton, of New York (who assisted Paul Treutler, a New York chemist, in the recent translation from the German of Chemist Hensel's work on hydrogen peroxide, a work which I presume we can soon obtain). Dr. Dayton now cures nose, ear and throat troubles, in persons of tuberculous diathesis, with this agent, locally and internally, even in cases that had resisted all ordinary treatment. He thinks a two per cent. solution strong enough for internal use. He says: "That the article has a future among the most trusted resources in the *materia medica*, I have no doubt."

Dr. H. C. Houghton, of New York City, author of the new work, "Clinical Otology," in his paper at the St. Louis meeting of the American Institute of Homœopathy (June, 1885), said : "Peroxide of hydrogen is of especial value in cases of obstinate chronic suppuration of the middle ear, especially in those in which it is very difficult to reach all the suppurating tract by any local agent. Its action upon purulent processes is marked by the evolution of the gas, and inspissated accumulations are disintegrated and removed. The fact that it can be forced through the osseous sinuses without danger, if there be free exit for the gases, commends it to the difficult class of cases just mentioned."

Dr. Alfred Wanstall, of Baltimore, read a paper on hydrogen peroxide, at the same meeting of the Institute, and said that the class of ear cases in which he had found it most useful was that of diffuse inflammation of the external auditory meatus, where "it has no rival in loosening and dissolving the troublesome inspissated dermal secretions and exfoliations frequently met in these cases, and seems to exert a beneficial influence on the diseased process itself, probably from its stimulating effect." In chronic suppurative conditions of the middle ear he uses it as a cleanser, and then packs the canal with dry boric acid, which sticks and prevents exudation, and so dries up the discharge. He thinks the general value of the article as a remedial agent is overrated.

In my original article I purposely omitted the information contained in the U. S. Dispensatory, supposing it familiar to the profession, but from the many inquiries I have received I am led to believe that I was wrong, so I will enumerate a few of the uses to which Dr. Richardson put it : "It is of great value in chronic and sub-acute rheumatism ; acts like iodine in the removal of scrofulous tumors ; relieves the paroxysms of whooping cough, and cuts short the disease more effectually than any other medicine ; affords great relief in chronic bronchitis, with dyspnoea ; in the early stage of phthisis it improves digestion, and gives increased activity to chalybeate remedies, and in the advanced stages it afforded great relief to the dyspnoea and oppression, acting, indeed, in this respect, like opium, without its narcotic effects. As it improves digestion, it is useful in all classes of cases complicated with dyspepsia.

The *London Lancet* published a letter Jan. 11, 1868, from Dr.

Day, of Australia, describing a hopeless case in which he used this ethereal solution of hydrogen peroxide "in the hope of oxidizing the sugar in the circulation, and thus causing its elimination through the lungs instead of the kidneys." The dose was a half drachm in one ounce of distilled water, three times a day. "In less than a month the patient considered herself quite well." The *London Medical Times and Gazette*, Oct. 17, 1868, also published a cure made by Dr. Bayfield, of London. So, in diabetes, if you can't get syzygium jambolanum, try ozonic ether.

Dujardin-Beaumetz last year reported experiments with the plain hydrogen peroxide before the Société Thérapeutique, more especially in severe cases of anorexia, polydipsia and diabetes. Great improvement followed in all but the latter. In fact, in regard to the anorexia, "return of appetite was readily accomplished without causing any gastralgia or other untoward symptoms." (*N. Y. Med. Record*, Oct. 31, 1885, p. 484.) Many of my cases prove the truth of this, first announced by Dr. Richardson, the godfather of the article.

But I believe that the great field for hydrogen peroxide is by inhalation—for then we catch the nascent, just-born, life-giving element peculiar to oxygen. In the *Circle of the Sciences* we read this sentence: "The general effect of oxygen in nature is that of a life-giving principle." Ever since the discovery of oxygen by Priestley has this idea been uppermost in the mind medical, for, since respiration is the process of administering oxygen to the tissues of the body, through the agency of the blood (and in the lungs purifying the life fluid), the thought instinctively pops into the mind that if, in cases of disease or imperfect oxygenation, we could help the lungs to more than their usual amount of oxygen, we would be wielding a weapon of vast remedial effectiveness. Years ago that great philosopher, our revered Dr. Constantine Hering, in alluding to the fact that an attempt was being made to impregnate water with oxygen, predicted that such a production would become a remedial agent of great power. Though expectations may not have been fully realized, on account of its narrowed use, much good has been done with this agent by inhalation in many diseases, more especially catarrh, asthma, bronchitis, phthisis, whooping cough, anæmia, anorexia and impure blood.

The Frenchmen, Bert and Regnard, were the first to recommend hydrogen peroxide as an inhalation in phthisis.

My method of using it is simple. Any ordinary inhaler is half filled with very pure water, a tablespoonful of the peroxide is added, the inhaler is set in a tin cup of hot water, and full inhalations are made for ten minutes, not taking tube from lips. Let inhalations be deep, exhale through the nose, and sit erect. In cases of catarrh inhale with tube in the nostril, exhaling through the mouth. Do this morning, noon and night, preparing fresh each time. Do not go into cold air for half an hour after inhalation. Also take internally, three times a day, one teaspoonful of the peroxide in a little inhaler water. According to the U. S. Dispensatory, when mixed with water it takes at least 100 degrees to evolve the oxygen.

During the past two years I have used nearly 100 one-pound bottles of the peroxide, and do not remember to have heard that no good resulted in any case, while many favorable reports have come in. Dr. J. T. Thompson, of New Castle, Ind., writes: "My asthma patient's cough is better than it has been for three years." Dr. T. B. Gullefer, North Vernon, Ind., and Dr. J. D. George, Franklin, and many others, also praise it highly. A lady from Brookville writes: "Nothing controls my cough like the peroxide."

I suppose I should adduce a few cases, but time is short. It was especially useful in the case of a young man who suffered from a crushed tibia just above the malleoli, the joint and foot being somewhat involved, and necrosis of parts of the lower third of the tibia resulting, the whole leg one large fracture blister, several tendons sloughing away, and numerous sinuses developing. The case was seen by several surgeons of both schools, and the general

verdict was that amputation should have been performed, or would have to be performed, to save life. The temperature reached $105\frac{1}{2}^{\circ}$ on two successive days, and the outlook was far from encouraging. Hydrogen peroxide was then procured and syringed in freely, and did invaluable service. The patient's father and mother have told me that they thought it saved their son's life.* It was useful in a herniotomy case, where the wound gaped and the silver sutures cut their way out ten days after the operation, owing to the vitiated condition of the man's system. A case of plastic operation on the nose, requiring six operations, afforded the hydrogen peroxide a fine opportunity to display its peculiar and unrivaled abilities as a disinfectant and cleanser, and whenever a bad smell or offensive taste appeared, the patient was sure to call for "some more of that stuff." A large, open cancer of the mamma, that discharged enormously, was kept deodorized by it, and the pain was much lessened. Perhaps an entirely original application was that, in two cases, where, acting on the knowledge of its ability to effervesce and destroy blood, and of its harmlessness anyway, I put four drachms of it into the vagina soon after having extracted the placenta. The parts were well cleaned, certainly; that any other good was done by it I cannot say, more than that the cases progressed without the least complication. I applied some of it to a large brown spot on a woman's arm; in two or three days the color was much paler, but as to the final outcome I am ignorant, as I have not seen the patient since. A small carbuncle was prevented from spreading by it, followed by iodoform dressings. It rendered good service in a severe case of ophthalmia neonatorum. A case of pulmonary phthisis—straight history of severe hemorrhages, night sweats, emaciation, sputa, etc., with a temperature of $102\frac{1}{2}^{\circ}$, responded so well to inhalations of the hydrogen peroxide, that in one month the temperature was normal all the time, sweats and dyspnoea entirely relieved, appetite good, and in two months, with cough almost stopped, the young man went back to work at his trade. This was a very instructive case, and had been under observation eight months before this treatment, being thought doomed by many; and remains well, three months after cessation of treatment. (One year later the report is that this young man

* During the proceedings of the Bureau on Surgery, this young man came in on crutches, and the leg was dressed, demonstrating the mode of application and the utility of the hydrogen peroxide.

joined a new military company here, and drills with the rest of the boys.) Another phthisis case—a young lady—improved on it wonderfully; a complete amenorrhœa of eight months' duration was a feature, and in two months she “came round,” and continues so. She is now in Arizona, and has her supply sent regularly, as does another lady now in Tennessee. A twelve-year old girl suffered severely with asthma for four years and was apparently completely cured with two pounds inhaled at home, in connection with daily inhalations of modified oxygen gas for a month at my office. She has been under observation several months since, and remains well, having improved wonderfully in many respects.

But I will not longer detain you clinically, except to call your attention to a disease, or cause of disease, often overlooked, in which the peroxide would work wonders. This disease, perhaps oftener recognized by first-class dentists, for want of a better name may be called septic dyspepsia, and often occurs where there is a mouth more or less full of carious teeth filled with germs, as the microscope so easily shows. The buccal cavity not being properly cleansed, unless tobacco is used, putrefaction ensues, and the constant deglutition going on transfers germs, pus, etc., to the stomach, where more or less trouble is set up. Or poisonous matter may be absorbed direct and the general health become mysteriously affected. An occasional gargle or swallow of the peroxide would be of great service here. Perhaps an occasional dose of merc. cor. low, would do well, too. But let any sceptic, I care not how clean-mouthed, take a teaspoonful of the peroxide into his mouth, “swishing” it around with his tongue—and he will be surprised at the result.

Dr. Brown, Harvard, Neb., detailed in the *St. Louis Medical Brief* (Aug., 1885) his inability to relieve or save a man with a blood clot in the bladder. I wrote him to effervesce it with the peroxide through a catheter, and he thanked me for the suggestion. This expedient is better than the ingenious one I read of where liquid pepsin was passed in to digest the mass and render it easy of expulsion.

The urinalysis tests alluded to are as follows :

Blood—To a half-drachm of Guaiac tincture add a few drops of the urine, and then trickle down side of tube a half-drachm of

hydrogen peroxide. A blue color at juncture shows blood. This is practically the same as the Almén test.

Pus—Urine containing pus, on standing awhile, generally becomes quite clear above the sediment. With a pipette transfer a little sediment to a watch crystal and add a few drops of hydrogen peroxide. If pus is present effervescence will be there also. (The microscope is, of course, the best test for pus.)

Chyle—On urine containing chyle a cream will form. Skim this off and treat the same as for pus; the reaction is the same.

I have said that pure hydrogen peroxide has the wonderful power of giving off 475 volumes of oxygen—that is, when liberated the oxygen flies off in the form of gas, in volume 475 times that of the water in which it was confined. But for none of the uses I have indicated is a strength greater than a fifteen-volume solution needed, and often this may be diluted half to two-thirds. It must be kept cool, quiet and corked, as the oxygen begins to escape at a temperature of about 60° or when the liquid is agitated. But, according to the U. S. Disp., when added to water, it requires 100° at least to decompose it.

The genuine article, Chas. Marchand Peroxide of Hydrogen which is sold by Earnest Drevet, No. 10 West Fourth street, New York City, is a fifteen-volume solution and contains 1-300 phosphoric acid, 1-600 sulphuric acid and 1-4500 muriatic acid, quantities so small that I now use this article without neutralizing it with baryta water.

NORTH AMERICAN JOURNAL OF HOMŒOPATHY.

ORIGINAL ARTICLES IN MEDICINE.

July, 1886.

HYDROGEN PEROXIDE.*

BY W. W. BLACKMAN, M. D.,

Brooklyn, N. Y.

Although discovered sixty-eight years ago by Thénard, it was not until recently that hydrogen peroxide emerged from its protracted obscurity, and became recognized as a remedy possessing great therapeutic value. But meagre information concerning it can be obtained from recent text-books on general or medical chemistry, and these ignore entirely its value in the domain of medicine. It is, however, gaining substantial repute in the profession, and although its recognition as a valuable addition to our therapeutic resources has been slow, it has steadily increased,

The tardiness of its introduction has, no doubt, been due largely to the difficulty experienced in obtaining the product in a sufficiently pure state for medicinal purposes.

The formula for hydrogen peroxide is H_2O_2 , or H. O. It has been variously named hydrogen peroxide, hydrogen dioxide, liquid hydrogen and oxygenated water. The terms liquid oxygen and oxygenated water are erroneously applied, since it is neither water nor oxygen, but a distinct and definite compound of hydrogen and oxygen containing twice as much oxygen as does water.

Hydrogen peroxide exists free in the atmosphere in the form of vapor, and from its close resemblance to ozone, in certain chemical relations, it is really questioned whether the many atmospheric conditions attributed to the latter are not due to the former. Its existence in the atmosphere was proven by experiments made by Schöne, near Moscow, in 1874. He found it to exist in rain water, snow and in artificial dew. During six months' observations he found that the quantity in the rain water varied from 0.04 mg. per litre to 1 mg. per litre, and in but two instances was there more than 1

*Read before the N. Y. Society for Medico-Scientific Investigation,

mg. observed. This variation in quantity was noticed to exist under certain conditions, viz.: after long dry weather the first rain that fell contained less hydrogen peroxide than that which fell subsequently, probably on account of the organic matter in the air; but during long continuous rain the quantity generally diminished considerably. As a rule the smaller the drops of rain the less the quantity of hydrogen peroxide contained in them; the proportion often varied in different showers falling the same day, the highest average amount was obtained when south and southwest winds prevailed. Of all the samples of natural dew and hoar frost tested, none contained sufficient peroxide to be detected by ordinary reagents. The artificial dew and frost prepared during the night, especially during the earlier part of the night, also yielded no indications, or at most only slight traces, but it was present in those condensed after sunrise, and the quantity increased with the altitude of the sun: the maximum being obtained between 12 M. and 3 P. M. After a fall of rain, however, the amount found in artificial dew was only one-third of the quantity obtained in fine weather. Hence Schöne concluded that hydrogen peroxide was not formed at the moment of condensation or subsequently, but existed previously in the form of vapor, and was washed from the atmosphere by the falling rain. This was confirmed by confining a condenser under a bell glass with a basin of water. The dew condensed under these circumstances contained no hydrogen peroxide.

Hydrogen peroxide is formed by decomposition of water by electrolysis. It is also produced in some cases of slow oxidation of water, especially in instances where ozone is formed. The simultaneous formation of hydrogen peroxide, ozone and ammonium nitrate, in the combustion of hydrogen in the air, may be shown by burning a small hydrogen flame under a funnel having its neck drawn out to a long tube. The gases issuing from the tube smell strongly of ozone, which may be further identified by ozone paper. The water which condenses is perfectly neutral, and the presence of hydrogen peroxide and ammonium nitrate may be demonstrated by the reactions of these compounds with potassium iodide.

“Hydrogen peroxide is produced when peroxide of potassium, sodium, barium, strontium, or calcium is digested with an acid, which forms a soluble salt with the base resulting from the decomposition of the peroxide, the excess of oxygen not escaping as gas, but passing over to a portion of the water and converting it into hydrogen peroxide.” Thus it may be prepared from barium perox-

ide by double decomposition with hydrochloric acid, $\text{BaO}_2 + 2\text{HCl} = \text{H}_2\text{O}_2 + \text{BaCl}_2$, the product being hydrogen peroxide and Barium chloride. It is doubtful whether it is ever found entirely free from water. Its preparation in a pure form is difficult. A dilute solution may be found by evaporation *in vacuo* over sulphuric acid, and it was obtained in this way by Thénard. The pure substance is a colorless, transparent syrupy liquid, which, when poured into water, sinks before mixing with it, having a specific gravity of 1.452. "It does not freeze at 22°F ., evaporates *in vacuo* at ordinary temperatures without decomposition, though much less rapidly than water; does not redden litmus, but gradually bleaches both litmus and turmeric paper; has a harsh, bitter taste; whitens the tongue and thickens the saliva. When placed upon the hand it instantly turns the cuticle white, and after a time produces violent itching." Hydrogen peroxide is miscible in all proportions of water, part of the water freezing out on exposure to the cold. It also unites with acids—*e. g.*, phosphoric, sulphuric, nitric and hydrochloric, forming mixtures in which it is less easily decomposed than when alone. Pure hydrogen peroxide is an exceedingly unstable compound, the second atom of oxygen being retained by the hydrogen very loosely. Under various and often enigmatical circumstances it separates from the water in the form of gas, which amounts in volume to 475 times that of the liquid. The gas often escapes with such rapidity as to produce violent effervescence, and at high temperature even explosion; heat is also produced, and when the experiment is made in the dark, light is apparent.

"In the circuit of the voltaic battery hydrogen peroxide, like water, is gradually resolved into hydrogen at the negative pole and oxygen at the positive pole, only that the proportion of oxygen is greater than in the decomposition of water." At freezing temperatures it decomposes very slowly, merely evolving a bubble of oxygen now and then, the decomposition not being completed for months. Sunshine does not appear to accelerate the decomposition at ordinary temperatures. Certain substances, among which are included charcoal, many metals and some metallic oxides, induce, by their mere presence or contact, a more or less violent decomposition of hydrogen peroxide into water and oxygen, without themselves undergoing any change. Gold, silver and platinum, when in the precipitated or finely divided state, act most violently in this manner, and cause a great disengagement of heat. In this respect it resembles ozone. A slightly acid solution, however, is less amen-

able to the action of these agents than is the pure aqueous solution. Alkalies, on the other hand, facilitate the decomposition. One of the most remarkable circumstances connected with hydrogen peroxide is its property of acting not only as an oxidising, but also as a reducing agent. The concentrated solution acts with great violence upon certain of the elements, selenium, arsenic, molybdenum, chromium, etc., converting them into their highest oxides. Whether pure or in aqueous solution, it will convert arsenious into arsenic acid, sulphurous into sulphuric acid, sulphide of lead into sulphate of lead, etc. But when added to the protoxides of silver or mercury, the peroxides of manganese or lead, not only is oxygen evolved from the peroxide of hydrogen, but also from the other existing body.

Hydrogen peroxide is readily decomposed by certain animal matters. It was thought, for a time, that blood fibrin was the only animal matter which had this power; but it has since been shown that defibrinated blood has the same action, the power of decomposition seeming to reside in the serum. Glandular structures have an especial power of decomposing it—*e. g.*, the tissues of the liver, kidney, spleen and pancreas, when rendered entirely free from blood by repeated washings, will decompose it readily. Musculin, and all forms of cartilage and fluids containing fibrin, also decompose it; but egg, albumen, yolk of egg, casein, milk, the chrySTALLINE lens and humors of the eye, fat, starch, sugars, juices of fruits, urine, urea, saliva, pericardial and peritoneal fluids, do not decompose or seem to affect it in any way. An eight volume solution mixed with milk will preserve it indefinitely. It has an especial affinity for animal coloring matters, and destroys them completely, rendering the tissues perfectly white. It is used extensively to bleach bones, ivory, silk, feathers and hair. It will remove freckles, sepia spots, and other chromatoses. It converts drying oils into non-drying oils. The value of hydrogen peroxide as a reagent is daily becoming more apparent, though its difficulty of production and the impurity of the preparations found in the market has tended to prevent its general use in the laboratory. It is a delicate test for chromium and its salts, and it has been used successfully in analytical determinations; it is also valuable as an oxidising agent. In urinalysis it is an important reagent.

Test for chyle.—If the cloudy or milky urine of chyluria be allowed to stand, a distinct jelly-like clot of fibrin floats on its sur-

face. If this be carefully removed and brought in contact with hydrogen peroxide an active effervescence takes place.

Test for blood—In a test tube filled one-third full of the tincture of guaic, add a small quantity of the suspected fluid ; then carefully allow an ethereal solution of hydrogen peroxide to run down the side of the tube. If blood be present a blue line will be noticeable at the line of juncture.

The test for pus is not entirely accurate, but may be found to be valuable as a comparative one. It consists in the power of hydrogen peroxide in producing an effervescence when brought in contact with pus corpuscles.

In the field of medicine the virtues of this remarkable product of the laboratory are only beginning to be appreciated.

Administered internally it has not been practically demonstrated to possess especially meritorious features, and testimony regarding this method of its use is conflicting. Old school practitioners have used it on the theory that it yields oxygen and destroys septic poisons, and converts harmful substances in the fluids of the body into forms suitable for excretion, and at the same time acts as a stimulant. It has been given internally for low fevers, cancer, scrofulous tumors, atonic dyspepsia, diabetes and epilepsy. One writer claims that it is a spinal irritant, and affirms that four hundred minims of the four per cent. solution will produce convulsions and death in a large, healthy dog. **We have administered doses varying from one hundred to six hundred minims of the fifteen-volume solution to a healthy dog with no other effect than to produce vomiting of large quantities of frothy mucus. which afterward changed to thick heavy masses of mucus.** Nor did hypodermic injections produce any abnormal signs, except a crepitant condition in the vicinity of the puncture, due to the presence of the gas liberated beneath the integument. The application of hydrogen peroxide in medicine has been chiefly confined to external use, and it forms an exceedingly valuable addition to the armamentarium of antiseptic surgery.

It is one of the most potent antiseptics and disinfectants yet discovered. Careful comparative tests with antiseptics now much in vogue, prove it to be sixty times as powerful as carbolic acid, twenty times as strong as salicylic acid, and forty per cent. more potent than the solution of the bi-chloride of mercury. This is extraordinary, and may seem incredible ; but experiments place it beyond a doubt.

As a disinfectant it is superior to chlorine gas or the fumes of sulphur. It enters rapidly into combination with the offending matter, destroys it completely, and, being decomposed into water and oxygen, leaves no substituted odor in place of the one removed. A constant spray of dilute hydrogen peroxide will purify a sick room more rapidly and effectually than any other known substance, unless it be a current of pure oxygen, which is essentially the same thing deprived of the solvent properties of the aqueous element. It will cleanse and render aseptic the skin, hair and clothing of patients and attendants; also the walls, floors and furniture of sick rooms and hospital wards. Used as a spray in surgical operations, it is superior to the bichloride of mercury or carbolic acid, and is free from the corrosive properties of one and the disagreeable odor of the other. If a decomposed egg be mixed with a small quantity of a twelve-volume solution of hydrogen peroxide, an active effervescence will take place, and the odor of the sulphuretted hydrogen be at once dispelled; when brought in contact with pus or putrid meat, the same active effervescence will be observed, and the odor, however foul, will be instantly destroyed. It promptly disinfects all forms of putrid excreta and destroys at the same time, all septic germs. It controls almost all micro-organisms, being a certain germicide and a potent sporacide as well. It instantly arrests the process of fermentation, even when mixed in the proportion of three parts to ten thousand of a fermenting saccharine solution. "It is the most powerful anti-putrid application known. Observed under a microscope the rapidity and thoroughness with which hydrogen peroxide acts upon pus corpuscles and bacilli is well illustrated. The corpuscles at once lose their spherical form, shrink, assume a concentric shape, and become heaped up as a mass of detritus, and in a few seconds the bacilli are transformed into a dead mass."

When applied to the skin in a concentrated form it is a powerful vesicant and irritant; but the dilute solution is as bland and non-irritating as water. Its virtues as a dressing for all pus-discharging surfaces have been highly lauded. From its power of destroying pus and all products of degeneration of tissue it has no equal as a cleansing agent. All observers agree in this respect;

but whether it possesses specific curative properties seems to be a disputed point. Certain it is, however, that irritable surfaces are not only cleansed but soothed by it, and soon develop healthy granulations. Its *modus operandi* is by yielding up and setting free one equivalent of oxygen, which, no doubt, is in a nascent and hyperactive state, leaving behind simple water. Its range of application is a wide one. It is especially useful in cleansing cavities difficult of access, alveola abscess, mastoid abscess, lumbar abscess, in suppurative inflammation of the middle ear, in empyema, and in sinuses wherever found. The foulest and most putrid cavities it renders aseptic and entirely void of unpleasant odor. It is applicable to the syphilitic as well as the simple ulcer, and whether applied to a syphilitic, eczematous or varicose ulcer, it exerts a soothing as well as cleansing, and, in the opinion of some observers, a decided curative effect. When applied to a venereal sore, to a foul, sloughing ulcer, a sluggish wound or to an oozing carbuncle, not only is the pus destroyed but the sore is thoroughly cleansed and rendered aseptic. As long as pus or carious exudations are present the effervescence continues. As soon as the ulcer is fully cleansed and all morbid tissues destroyed the bubbling ceases; nor will fresh applications reproduce it. Hydrogen peroxide is especially useful in diseases of mucous surfaces which have pseudo-membraneous deposits or purulent discharges. It destroys readily lymphous, aphthous and pseudo-membraneous patches wherever thorough application can be made. It may be applied directly to ulcerated surfaces on the tonsil and pharynx, and used as a mouth wash in stomatitis. In purulent ophthalmia, whether of specific or simple origin, and purulent affection of the ear passages, it is used with unvarying success. Used as a wash and applied on absorbent cotton to an eroded cervix uteri, better results are obtained than from any other method of local treatment. From its property of destroying pseudo-membrane it would be at once inferred that a particular field of its therapeutic use is in the direction of combating the dread disease diphtheria, and accordingly clinical tests thus far made seem in most instances to corroborate the inference. It must not be supposed, however, that hydrogen peroxide is a specific for this condition. It should be applied early in the disease, before systematic infection has too far progressed, and before the deposit has in-

vaded inaccessible parts, either by spray, douche or gargle, one or all, according to the feasibility of the case.

It promptly decomposes the membrane and destroys the factor of the breath. The membrane does not exfoliate, but seems to be completely dissolved, leaving a clean granulating surface. It is doubtful if it has any specific effect on the disease, but as a valuable accessory to the treatment it will, in many cases at least, ward off the danger of suffocation. It is needless, to prescribe it on the theory that diphtheria is an infection of the patient by absorption of the poisonous material of the false membrane, for diphtheria is a disease which primarily affects the whole system. Decomposition of the false membrane may, and often does, no doubt, become a source of secondary toxæmia. The poison, then, is not diphtheritic, but the result of absorption of putrid matter, and peroxide of hydrogen will unquestionably prevent this secondary toxæmia. It is true that local applications in this disease are usually exceedingly mischievous; but we cannot see how the use of hydrogen peroxide, *if perfectly pure*, can be in any way injurious. It is itself non-irritating, and it promptly decomposes into oxygen and water. It ought to prove effective in membranous croup, but so far as we know, clinical tests in this disease have not been made. Even if it should not dissolve the croupous membrane it would supply the much needed oxygen to the little sufferer.

Hydrogen peroxide is useful for washing out the stomach or bladder when conditions involving degenerative lesions of their mucous membrane exist. In gonorrhœa and leucorrhœa it is an excellent remedy.

In the treatment of the diseases of the respiratory mucous membrane commonly associated with the tubercular diathesis, we find in hydrogen peroxide a valuable adjunct. It has given positive relief in cases of phthisis—laryngeal and pulmonary—cases having a history of hemorrhage, sputa, night sweats and emaciation. Even in the last stage of the disease, it will relieve the cough, check the sweats and lower the temperature.

It possesses some local anæsthetic properties, or the gas evolved during its action has this effect. It is painless in itself, and when applied to painful and irritable surfaces the pain is notably relieved.

Hydrogen peroxide must not be used indiscriminately or without knowledge of its

purity and strength. A number of samples offered in the market are wholly unfit for medicinal use, and much has been sold under the name of it that contained no peroxide at all. No experimenter, however, should be discouraged by preliminary failures. It should be thoroughly tested before used, and if found to be impure should be let entirely alone. It must be neutral to litmus paper, and should have no odor. It should dispel quickly the color from a weak solution of permanganate of potassium. There seems to be an erroneous impression prevalent regarding the difference between the percentage and the volume solution, the latter being often mistaken for the former. The ordinary commercial preparation is from ten to fifteen volumes strong, but this is often sold for a ten or fifteen per cent. solution. As previously stated pure hydrogen peroxide yields four hundred and seventy-five volumes of oxygen; that is, it gives off four hundred and seventy-five times its own volume of oxygen.

The pure substance is, of course, 100% strong, and yields four hundred and seventy-five volumes of gas. A 1% solution, then, is equal to a 4.75 volume solution. A fifteen-volume solution contains therefore, a trifle more than three per cent. of the real hydrogen peroxide. A percentage composition of the pure substance reserves 5.88 per cent. of hydrogen, and 94.12 per cent. of oxygen.

Owing to the unstableness of the article the preparations usually found in the market are acidulated with sulphuric acid, which aids in the preparation of it. This free acid should be neutralized before use. This may be done by adding baryta water, drop by drop, until turbidity ceases to form. The insoluble base, barium sulphate, is the result. Then filter, or allow to stand

until it is quite clear ; then decant the clear liquid, leaving the precipitate as refuse.

The dose of hydrogen peroxide is from one to three tea-spoonfuls of the two-volume solution, and is usually given three times a day.

For local use on mucous surfaces better results are, as a rule, obtained from a two or three-volume solution than from a stronger preparation, and a two-volume solution is strong enough to apply to fresh wounds. In cases of chronic ulcers and indolent sores, however, it is sometimes necessary to use it as strong as ten volumes. Its effects can be controlled according to its concentration. One great objection to the general use of Hydrogen peroxide is, that it requires too much testing before use, this will, no doubt, tend to prevent its general acceptance by the profession.

It must be used intelligently. It is to be feared that the peroxide will be condemned, as it has been already, because of failures from the use of impure and improperly neutralized preparations. If properly diluted, and if *pure*, it is as bland as water, and has nothing caustic, irritating or poisonous about it.

It is not the purpose of this paper to more than call attention to a remedy which must, ere long, occupy an important place in the treatment of the diseased conditions which have hitherto been tedious and often unsatisfactory. New remedies and new applications of old remedies are introduced which are accepted by the profession with a rush, as it were, and for a time become very popular and then gravitate to their proper level, which in some instances is obscurity.

Hydrogen peroxide is worthy of careful study and patient investigation, and when accorded its proper place it will occupy a high position on the list of our therapeutic resources.

NOTE :—Charles Marchand of 10 West 4th street, New York, manufactures an excellent preparation. It is an acidulated solution, fifteen volumes strong.

THE OXYGEN TREATMENT.

BY WILLIAM B. CLARKE, M. D., INDIANAPOLIS, IND.

Read at the Twentieth Annual Session of the Indiana Institute of Homeopathy, Indianapolis, May 25th, 1886.

In 1774 Dr. Joseph Priestley, of England, made the greatest discovery of the last century—oxygen—and one which marked a great era in the progress of human knowledge, for, as has been well said, “It put an end to old theories, laid the foundation of modern chemical science, and furnished the master key by which man has been enabled to unlock the mysteries of Nature.” (Youman’s Chemistry.) As intimating how vitally oxygen is linked with the course of earthly affairs, Liebig says that “since its discovery the civilized world has undergone a revolution in manners and customs. The knowledge of the composition of the atmosphere, the earth, water, and of their influence upon the life of plants and animals, was linked with that discovery. Trades, manufactures, and the separation of metals from their ores, stand in close connection therewith. The prosperity of empires has increased manifold, and the fortune of every individual has augmented in proportion.”

The outcome of this discovery has been astounding, but in these short limits we cannot trace it. But I will say that the whole surgical world—those who cut and those who are cut—owes a vast debt of gratitude to the early investigators along the oxygen line, for their labors led right up to the discovery of our present means of producing anæsthesia, and thus increasing advisable surgical operations an hundred fold. For Priestley’s discovery gave a strong impulse to the study and application of “different kind of airs and gases,” and in 1800 Sir Humphrey Davy announced that “nitrous oxide appears capable of destroying physical pain, and may be used with advantage during surgical operations.”

After this brief glance at the purely material value of oxygen, let us look at its bearing on the animal life: Our first and last gasps are for oxygen, and deprived of it a very few minutes we die. It constitutes one-fifth the volume of the air we breathe, and eight-ninths of the weight of the water we drink, three-fourths that of all animal bodies, four-fifths that of the vegetable world, and one-half of the ponderable matter of the solid earth itself. Without it all ordinary artificial light were impossible, as well as the purifica-

tion of stagnant streams, and air breathed a few times is no longer capable of sustaining human life.

The rarest thing in nature—I should perhaps say the art-nature of to-day—is uncontaminated air, vastly more so than when Hahnemann wrote his article, “Things that Spoil the Air,” (published in 1792), at the close of which, after pointing out the dangerous practices of the people, he wails: “Where is the compassionate man who will teach them something better?” Nowadays our health boards do much in the right direction, but the need for good work constantly grows apace with the growth of our country, for our air is defiled by dust, smoke, fires, smells (if not sights and sounds), in countless ways entirely unnecessary to mention. But it is not out of place to welcome the electric light as a great stride, by virtue of its intimate relation to the science of ventilation, as it does not destroy oxygen, and gives 90 per cent. light and 10 per cent. heat, instead of *vice versa*, as gas does.

It is always in order to tell the familiar yet terrible story of the Black Hole of Calcutta—how 146 stalwart English soldiers were crowded into a room 18 feet square, which had two little windows on one side. Soon began a fearful struggle for a place at a breathing hole. In 10 hours the door was opened on 123 dead men—dead for want of oxygen. The history of the 23 survivors recites that more than half of them died not long after of putrid fever or some form of blood poisoning.

As familiarity breeds contempt, so we unconsciously appropriate oxygen, and many other great blessings, in a matter-of-course sort of way, and press on recklessly in our struggle for other worlds to conquer.

The Creator “breathed into his nostrils the breath of life, and man became a living soul.” Disclaiming any pedagogic desire to read you a lecture on simple physiology, it may yet be profitable to trace the course and work of this “breath of life.”

We will liken a lung to a bunch of grapes—the stems being air passages, each grape being a “pulmonary lobule.” Each grape is cut up into about 25 rooms by membranous partitions, that do not quite reach to the top of the room. These rooms are the “air vesicles.” The membranous partitions are practically but little blood vessels, for these vessels are so thickly distributed that a needle point put down on a partition would be more likely to touch a blood vessel than the space between it and another. These rooms are continually expanding and contracting as air goes in and out. Air

is a simple mixture of one part oxygen and four parts nitrogen, and each of us breathes of it in 24 hours 140 times the bulk of our body, the oxygen *consumed* being seven times our bulk.—(Dalton.) When we draw air into the lungs—or bunches of grapes, if you will—each grape expands, or should expand, and a large surface of membranous partitions is thus exposed to the in-rushing air. The oxygen of the air has a greater affinity for the blood, especially for the iron in it, than for its associate nitrogen, so it leaves the nitrogen and passes directly into the blood, regardless of the partition. The carbonic acid in the blood has its affinity for the nitrogen which the oxygen has just left, so it passes outward through the partition into the cavity of the grape, and is breathed out of the body. So the dark, venous, poisonous blood is changed into the bright, arterial, life-supporting fluid, in a manner both simple and wonderful. Then, too, we must remember that this vivifying influence must also operate on the lymph, which mixes with the impure blood just before it drops into the heart. “Lymph is never pinkish when drawn from its vessels, but becomes so after it has been exposed to the air for a short time.”—(Dalton.)

The blood is now charged with oxygen, which must be carried to the tissues of the body and be appropriated there. Hæmoglobine, the red coloring matter of the blood, is the great oxygen-carrier. It takes up oxygen freely (in amount dependent on the muscular activity going on), holds it in loose combination, and parts with it readily. It is estimated that the blood is capable of being saturated with about three times the amount of oxygen it can ever get from ordinary air when the body is at rest—a most important fact in relation to the inhalation treatment of anæmic or bed-ridden patients. Bernard first made the observation that oxygen is stored up in the body during sleep. Hæmoglobine contains more iron than any or all other parts of the body, and in passing, it may be well to say that, as iron is, theoretically, at least, an oxygen carrier, it seems reasonable to administer oxygen and iron together in many cases. At any rate, in the oxygen-treatment and homœopathic similimum (if I may be allowed such a tautological license) should never be withheld. Frequently it will be iron, and often iron and nux vomica. Iron should preferably be used in combination with an acid, and in the ferrous organic, not ferric inorganic, form—the so-called Solution Ferrous Malate, for instance, a most stable and assimilable form.

In the short time now at my disposal I can do the subject of

oxygen inhalation as a therapeutic agent only partial justice. Records of countless cases of disease and poisoning so treated may be consulted without much trouble. The literature of the subject is rapidly increasing, and is now quite voluminous (as you will see by the partial list I shall append), and may be studied with profit by all. Should any enterprising publisher collect and print the articles here named a volume would be produced that would grace any medical library. I believe that Dr. C. E. Ehinger, of Quincy, Ill., is now engaged on a work on oxygen, to be published by Chatterton, Chicago.

The medical profession early appropriated oxygen, but as rubber hose was not then known, it could not be used skilfully, and as a poor article of gas was often used, results were not as good as they are now. About 1786, Dr. Beddoes (professor of chemistry at Oxford, and a practitioner of note), threw great energy into the work of investigating the therapeutic merits of oxygen, with satisfactory results, as detailed in his book, published in 1789. A building was erected for experimentation, and he was assisted by those giant minds, Sir Humphrey Davy, the chemist, and James Watt, the engineer, and others less known to fame. But the matter soon apparently soon dropped out of the sight of physicians, till 1860 to 1866, when Dr. S. B. Birch (of the Manchester Medical School), Dr. Hermann Biegel, of London, and Demarquay, of Paris, published the results of their investigations, each issuing a book, the latter first taking the form of a special report to the French Academy of Science and Medicine, "a body then as now most competent to judge of the merit of any scientific process or theory." An intensely interesting review of the whole matter appeared in 1870, in pamphlet form, from the press of D. Appleton & Co., New York, entitled *Oxygen Gas as a Remedy in Disease*, written by Dr. Andrew H. Smith (now of the New York Post-Graduate Medical School, and the Presbyterian Hospital), being the prize essay of the alumni association of the College of Physicians and Surgeons, 1870.

The most recent elaborate writings on the subject of oxygen are by Dr. Samuel S. Wallain, of New York. He is a specialist in this line, and probably the best informed one in the world. His valuable contributions began about 20 years ago. Any one wishing to become familiar with the oxygen subject, theoretically or practically, must study Dr. Wallian's writings, a list of which I will append. He seems to have been the first to have hit upon the expedient of combining oxygen, nitrous oxide, and ordinary air for

inhalation (unless Dr. Zeigler antedated him), and certainly has demonstrated its vast superiority over plain oxygen. He has quite recently been prevailed upon to assume charge of an oxygen supply depot, and will furnish full information. You can address him at 491 West 22d street, New York, and will always find him reliable in every way, scientific or business. His oxygen outfits are the best and cheapest that I know of, and possess the merit of having passed under the critical eye of an expert of years' experience, and of having been designed by one who knows just how to take advantage of all the fine points that have been decided in that experience. To give an example of Dr. Wallian's forcible way of putting things, and also to point out when the oxygen treatment is "the indicated remedy," I will quote from some of his later writings: "Malassimilation and perverted nutrition are at the bottom of the most prevalent and fatal forms of modern diseases, but do we fully realize the important fact that no atom of nutrition is ever converted into blood or tissue except through the direct and indispensable action of oxygen? And this is the key to the success of the oxygen treatment. In regard to the class of cases in which it is more especially indicated, I would say: To the general or constitutional betterment of nearly every chronic morbid condition to which the human organism is subject, no matter by what *name* it may be called. And it is a remarkable fact that in no single instance where the treatment has been accurately adapted to the case and thoroughly administered has it failed to respond with satisfactory and often with brilliant results." In all his writings he is full, open and explicit, as well as vigorous in denouncing shams and secrecy in formulæ and methods. He attaches great importance to the necessity of a patient "sticking to it" six or eight weeks, as the initial benefit is sometimes slow in coming, but after it comes he is often surprised to find that treatment may be discontinued a month and improvement continues uninterrupted, when treatment may be resumed.

Dr. Birch (previously mentioned) claimed that artificially evolved oxygen had remedial qualities quite distinct from the quiescent oxygen of the ordinary atmosphere, and Dr. Wallian indorses this view as correct. I suppose it is an allotropic condition, occupying a position between ordinary oxygen and ozone. It would easily take on an ozone character if charged with a current of electricity. A little electricity might impart a magnetic property that would be invaluable. And right here is a problem of considerable importance

for chemists and electricians to solve—to impart a magnetic or electric property to artificially prepared oxygen for inhalation and yet stop short of the powerful and dangerous ozone—as is done, for instance, by nature during a thunderstorm. You all have experienced the positive delight of breathing deeply the purest air we can get—right after a thunderstorm, and have mentally compared it with the air just before the storm. Yet, in the light of Mr. Draper's startling announcement and apparent demonstration that ozone in excess in the atmosphere causes pneumonia, I have felt quite timid regarding ozonic experiments on my patients, and have confined my inhalant to the Wallian formulæ of the modified gas—mixtures of oxygen, nitrous oxide and pure air. (See Ozone as the Cause of Pneumonia, Daniel Draper, director Central Park Meteorological Observatory. New York Medical Record, Sept. 19, 1885. p. 326, and editorial in same journal, Nov. 28, '85, p. 604, Influence of Ozone on Health.)

The modern pneumatic differentiation cabinet would doubtless prove a valuable aid in administering oxygen, but the exclusiveness (or codeishness) of its eastern managers, and the high yearly rental (\$250) detract from its availability. (LATER.—The Pine (Cincinnati) outfit may now be bought outright.)

Chlorate of Potash stands to-day the foremost early remedy in diphtheria and some forms of septicæmia, and Permanganate of Potash holds the same position in regard to amenorrhœa and snake bites. (The Emperor of Brazil recently presented Dr. Lacerdo \$20,000 in honor of his discovery in regard to snake bites.) These substances are notably rich in oxygen, and it would be interesting to know just how much this property has to do with their curative powers, and specially whether much of this power does not depend upon the peculiar nascent—just-born—condition of the oxygen as it begins to work in the human body.

Dr. Wallian asks, as I did two years ago, if the well-known comparative toxic power of chloroform and ether does not reside in the fact that the one gives off no oxygen, while the other does, thus making ether more safe physiologically.

The ptomaine question is assuming importance. Ptomaines are cadaveric alkaloids—the results of putrefaction—and fish and meat poisonings are common, especially among users of canned goods. The food may be perfectly good when the can is opened, but after a can is opened a ptomaine may develop in a short time and render the food poisonous. The alkaloids were discovered by Armand

Gautier, in 1870, and also by Selmi just after, and are treated of in Dr. Clifford Mitchell's new book, the *Physician's Chemistry*. Gautier lately claimed that these bodies are constantly being formed in life, and that their non-elimination, or non-oxidation, is the cause of many diseases, thus opening up a new pathology, as well as dealing the so-called germ theory the severest blow it has yet received. Gautier's remarkable communication regarding ptomaines and leucomaines, made January 12, 1886, to the French Academy of Medicine (see *Archives Générales de Médecine*, No. 2, 1886), takes the ground that these by-products of normal vital action came through a putrefactive rather than combustive process, and he says: "There would be a continual auto-infection from them if the skin, kidneys, bowels, and lungs did not act freely, and if the oxygen of the blood, which is their great enemy, were not continually supplied to the tissues." (This matter formed the subject of an editorial in the *New York Medical Record*, April 8, 1886, p. 392.) In July, 1884, I advanced the idea that many cases of peritonitis, septicæmia, puerperal fever and analogous troubles were caused by ptomaines. (*Indianapolis News*, July 14, 1884.) The fatal tyrotoxicon, from cheese, milk, pic-nic ice cream, etc., is first cousin, and is being watched.

I believe many physicians have become so accustomed to visiting stranded human wrecks in dark, ill-ventilated rooms, lying on bad smelling beds, and who are breathing only in the shallowest possible manner off the top of the lungs, that, disheartened by the results of their reform-efforts in the past, they have insensibly settled into a state of go-as-you-please passivity in the matter, and, regardless of the fact that an atonic, despondent condition invariably results from an excess of venous blood, they simply give the similitum, as near as they can, and retire, "trusting to luck." No wonder that ptomanies, leucomaines, and remains result! This pure-air subject has been so harped upon in all its phases that it has grown tiresome to many—goes in at one ear, and right out at the other. But I will quote Florence Nightingale's advice to her followers: "The very first canon of nursing, the first and the last thing upon which a nurse's attention must be fixed, the first essential to the patient, without which all the rest you can do for him is as nothing—with which I had almost said, you may leave all the rest alone—is this: Keep the air he breathes as pure as the external air without chilling him." The only improvement I can suggest is, keep it purer than the external air if you can.

Among the great problems connected with the water supply of great cities, the question, What becomes of the filth, especially nitrogenous compounds, poured into running streams as sewage, is the most important. It is only through oxygen that the solution of this problem becomes possible, for the filth that does not settle is oxydized, burned up, by the action of the extra oxygen dissolved in the water. The inventors of the Merrill fountain pump (Indianapolis made), and the Mild fountain pump (Cincinnati made), have utilized this fact, and by making the cups of an ordinary chain pump go down filled with air, and also producing a spray, they will, with one of these pumps, in a few minutes convert the foul-smelling bilge-water contents of an old cistern into a really fine drinking water. These pumps are deservedly becoming very popular.

The popular and mildly-exhilarating beverage in the principal Parisian hotels and restaurants is now distilled water, strongly charged with pure oxygen, and this at the suggestion of Dujardin Beaumetz. Can you imagine a purer beverage?

Brin Brothers, French chemists, have in operation an apparatus that produces 100 cubic metres of oxygen a day, directly from atmospheric air, at a low price, and another chemist is making it from water.

As oxygen can now be easily liquified by the Calletet process, we ought to be able, as Dr. Wallian says, to buy it in flasks at any drug store. A newspaper clipping says :

Professor Dewar has succeeded in the production of solid oxygen. At the Royal Institution he lately exhibited for the first time to a few friends the methods he employs. The successful device depends upon allowing liquid oxygen to expand into a partial vacuum, when the enormous absorption of heat which accompanies the expansion results in the production of the solid substance. Oxygen in this condition resembles snow in appearance, and has a temperature of 200 degrees C. below the freezing point of water. A supply of this material will enable chemists to approach the absolute zero of temperature, and to investigate many interesting changes in the physical properties of bodies under the primordial condition of the temperature of space.

A rapid, new, interesting and inexpensive way to make oxygen is to drop permanganate of potassium crystals into hydrogen peroxide. The evolution is instantaneous.

But we have to stick to the old stage-coach principles—slow but sure. The oxygen and nitrous oxide gases are easily made, as every

tyro in chemistry knows, so I need not dwell on the processes. Full details may be found in works on chemistry, and in some of the articles to which I shall presently refer, notably those of Drs. S. S. Wallian, A. H. Smith and C. E. Ehinger. But I will say that the Fresenius mixture is best of all, as, according to that noted chemist, the least possible amount of chlorine is evolved in the process of manufacture. He simply adds to thoroughly dried and powdered chlorate of potash 1-1000 part of sesquioxide of iron. Chlorate of potash is an exceedingly bad conductor of heat, and this, and other catalytic substances, simply act by transmitting heat from molecule to molecule. One retort charge of $\frac{1}{4}$ pound will make alone about 35 quarts of oxygen, according to Fresenius, and by Dr. A. H. Smith's method, one ounce makes about 500 cubic inches of gas. To make 100 gallons of nitrous oxide gas it requires $1\frac{1}{2}$ pounds of ammonium nitrate. I never make the nitrous oxide gas, as it can easily be bought at a dental depot, in 100-gallon iron cylinders, 14x4 inches, like the one now before you, and is perfectly pure, being compressed to a liquid, which flies into gas when the faucet is turned; it is made in Philadelphia, and costs \$4 a cylinder, four cents a gallon of gas.

The great utility of nitrous oxide in the inhalation mixture resides in its greater stimulating effect, I think, thus imparting a sensation of power, or rather imbuing the patient with the feeling that there is power in the thing. The three ingredients are usually mixed in equal proportions, unless, as before intimated, it is desirable to produce an impression of power in the mind of the patient, when more nitrous oxide is put in. The oxygen may be bought of the New York Oxygen Gas Company (or of the Wallian Company), compressed in 100 or 200 gallon cylinders, but the cylinders never come here, and I have preferred manufacturing the gas to paying expressage and buying the transportation cylinders. The New York Oxygen Gas Company distributes the Dr. Smith pamphlet I have spoken of, and the Wallian Company distributes reprints of Dr. Wallian's articles.

Water may be easily charged with these gases, and if kept cold will retain them. I prepare this water for several purposes, more especially for use in inhalers, either with or without hydrogen peroxide. Regarding the production of this "inhaler water," or "oxygenæqua," I will quote from my previous article on Hydrogen Peroxide: "Taking advantage of the fact that nitrous oxide is very soluble in cold water (it takes up three-fourths its volume, and

five times its volume under pressure), and oxygen somewhat soluble (one-twentieth its volume—U. S. Disp., or Younman's Chemistry; Dr. Wallian says three times its volume), all my inhaler water is so charged under pressure, and a little alcohol is added. A simple shaking of the bottle half-full of this easily develops ocular and aural evidence of oxygen *in statu qu.*"

For the benefit of those who wish to pursue this oxygen subject further, or become better posted on its literature and clinical importance, I have arranged a partial list of important books and essays upon it. In fact, this is the chief object of this paper—indicating where knowledge may be found, rather than imparting the knowledge itself in detail :

PARTIAL LIST OF OXYGEN LITERATURE.

- Considerations on the Factitious Airs. Dr. Beddoes, London, 1789. A review of this work was published in the British Library.
- On Oxygen. Dr. S. B. Birch, London, 1857 (2d Edition in 1868), and British Medical Journal, Dec. 24 and 31, 1859.
- Pneumo-Therapea. Dr. McCormack, London, 1856.
- Inhalations. Dr. Hermann Beizel, London, 1866.
- Demarquay's Reports to the Academy of Medicine, Paris, 1863, and in Paris Gazette Medicale, 1865, and his Essai de Pneumatologie Medical, published in Paris in 1866.
- Inhalation of Oxygen. Dr. Edward Mackey, (Professor of Materia Medica and Therapeutics, Queen's College, Birmingham,) Practitioner, May, 1869, (in phthisis).
- In Dr. H. P. Gatchell's articles on Force is shown the relation of oxygen to life, as he used to teach it in his lectures as far back as 1853. The articles were published in the U. S. Med. and Surg. Journal, vols. 4 and 5, and a good abstract may be found in Raue's Homœopathic Literature, 1870, p. 350-351, and p. 384.
- Oxygen Gas as a Remedy in Disease. Dr. Andrew H. Smith, New York, 1870, pp. 56. (Prize essay alumni association, N. Y. College of Physicians and Surgeons).
- Super Oxygenation as a Therapeutic Measure. Dr. S. S. Wallian, Chicago Medical Journal, 1869, p. 116-120 and 139-152.
- Oxygen and Some of its Compounds as Therapeutic Agents. Dr. Wallian, N. Y. Medical Record, 1883, p. 455-457 and 513-515.
- On the Preparation and Use of Oxygen and Congeners as Remedial Agents. Dr. Wallian, N. Y. Medical Record, 1884, p. 283-287 and 313-316.
- An Old Remedy Revived. Dr. Wallian, Transactions Vermont State Medical Society, 1884.
- Further Report on Oxygen as a Therapeutic Agent. Dr. Wallian, N. Y. Medical Record, Oct. 31, 1885, p. 483-488.
- Oxygen : A Rational Study of its Place in Therapeutics. Dr. Wallian, Philadelphia Physician's Magazine, Decembe, 1885, p. 103-114.
- Oxygen Treatment and Oxygen Charlatans. Dr. Wallian, Medical World, recent; (reprinted in pamphlet).
- Priestley's Discovery of Oxygen Gas. Dr. J. W. Draper, Popular Science Monthly, August, 1874, p. 385-398. A most interesting article, and with a portrait of Dr. Priestley.
- The Oxygen Centennial. Popular Science Monthly, Sept., 1884, p. 628. These interesting exercises were held at Dr. Priestley's old home in Pennsylvania, and many noted scientists were present.

- The Discoverer of Oxygen. *Popular Science Monthly*, July, 1872, p. 368-370.
- Air and its Relations to Life, being Hartley's lectures, p. 248. Published by Appleton, N. Y., 1875. It also contains Motay's process for extracting oxygen from air, treats of oxygen and carbonic acid, and is a book that every physician should study.
- Effects of Oxygen Inhaled at Different Temperatures. Dr. B. W. Richardson, *Popular Science Monthly*, Nov., 1878, p. 118. (More pronounced effect the lower the temperature).
- Dr. Geo. J. Zeigler of Philadelphia, in a small volume issued in 1860, claimed much for nitrous oxide, and his efforts at popularizing it succeeded; at least, quite a number of peripatetic one-tank oxygenizers began to roam the country, seeking whom they might devour. Many swindles have been perpetrated upon doctors and patients in the name of oxygen. One such I reported in the *U. S. Med. Investigator*, Nov., 1885, exposing "Dr." A. L. Lennard's practices in this particular. It was also printed in the *Chironian*, *Health and Home*, *Agriculturist*, *Medical Record* and others, attaining a circulation of about a million copies.
- Nitrous Oxide and Oxygen as an Anæsthetic in Labor. *British Medical Journal*, Nov. 7, 1885, detailing its successful use in 60 cases, by Dr. Zweifel, of Erlangen. A portion of this article may be found in the *Philadelphia Medical News*, Nov. 28, 1885, p. 598.
- Oxygen as a Therapeutic Agent. Dr. Claude E. Ehinger, Quincy, Ill., in *Chicago Medical Current*, Jan., Feb., March, April, May, June, July, 1886. Dr. Ehinger will soon issue a book under the title of "Oxygen in Therapeutics," published by W. A. Chatterton & Co., Chicago.
- Oxygen—Nature's Remedy, Dr. Renel Bartlett, Boulder, Colorado, in *U. S. Med. Investigator*, Feb., 1886, p. 79-82.
- Determination of Oxygen Dissolved in Water. Prof. Wurtz, in *Popular Science Monthly*, May, 1874, p. 126.
- An important article, though perhaps not germane to the matter, is *Spectroscopic Discovery of Oxygen in the Sun*, by Dr. Henry Draper, read before the American Philosophical Society, printed and illustrated in *American Journal of Science and Art*, and reviewed in the *Popular Science Monthly*, Sept., 1877, p. 618-620.
- On the Influence of a Diminished Supply of Oxygen to the Tissues on the Disintegration of Albumin in the Animal Body, being Frankel's experiments, taken from Virchow's Archives, in *New England Medical Gazette*, Jan'y, 1878, p. 42-44.
- The renowned Trousseau reports in the *Clinique Medicale de l'Hotel Dieu*, tome 3, p. 64, having with oxygen "recalled to life woman regarded as lost."
- Dr. Favr, of Kharkov, Russia, tried it in two severe cases of puerperal eclampsia, with brilliant results, which I should like to read. They were published in *Vratch*, 1885, No. 13, and partially in the *N. Y. Medical Record*, Oct. 31, 1885, p. 484.
- Dr. Bartholow, in his *Materia Medica and Therapeutics*, gives oxygen a page, and in other writings accords it a high estimate.
- Dr. J. B. Andrews had an article on oxygen in the *Detroit Review of Medicine and Surgery*, Dec., 1871.
- Dr. Golden's article in the *London Lancet*, March 10, 1866, is often quoted from. He used the gas in many troubles, and an original use was in applying it direct to ulcers and suppurating processes, in hospital practice. Even breathing oxygen will render bright red an old sore or venous blood drawn therefrom.
- In the *New York Medical Journal*, Oct. 17, 1885, p. 448, is reported a cure of leucæmia with oxygen by Dr. Kirnberger.
- Oxygen in the Treatment of Pneumonia. Dr. E. G. Janeway, *N. Y. Medical Journal*, Nov. 28, 1885, p. 618. (Dr. Janeway is Dr. Flint's college successor).
- Dr. Alonzo Clark, in *N. Y. Med. Jour.*, August 11, 1883, detailing success-

- ful treatment of two cases of poisoning with illuminating gas, in Bellevue Hospital, N. Y.
- Easy Liquefaction of Oxygen. *Lancet*, and in *N. Y. Med. Jour.*, Aug. 23, 1884, p. 199.
- Inhalation of Nitrogen in Pulmonary Disease. Dr. Sieffermann, *N. Y. Med. Jour.*, July 12, 1884, p. 56. Night sweats of phthisis controlled, and rapid disappearance of dullness due to infiltration of the apex; appetite improved, also sleep. (This quotation is of use because of its possible bearing on the question of mixing oxygen and nitrous oxide).
- The Use of Compressed and Rarefied Air, as a Substitute for Change of Climate, in the Treatment of Pulmonary Diseases. Dr. J. Solis Cohen. *N. Y. Med. Jour.*, Oct 18, 1884, p. 423-424, (illustrated).
- Rapid Breathing as an Anæsthetic. Dr. M. T. Yates, *American Homœopath*, Aug., 1883, p. 225-226.
- For results of experiments with oxygen in 10 cases of phthisis in the New York Hospital, see *N. Y. Med. Jour.*, Sept., 1869.
- Dr. A. H. Smith, *N. Y. Med. Record*, June 15, 1869—in bronchitis; and in *N. Y. Med. Journal*, May, 1869—in emphysema.
- Dr. Hooper, *British Med. Journal*, March 15, 1862—in asthma.
- Dr. Miguel. *Half-Yearly Compendium*, January, 1869—in croup.
- Dr. Butler, *N. Y. Med. Journal*, Nov., '69, in pneumonia, and Feb., 1870, in anæmia.
- Dr. De Smyttere. *Comptes Rendus*, Oct., 1848, especially in cholera.
- Dr. Paul, *Bulletin Gen. de Therap.*, tome 75, in poisonings.
- Dr. Byfield, *British Medical Journal*, Oct. 17, 1868, in diabetes.
- Dr. Ramskill, *Medical Times and Gazette*, July, 1863, in epilepsy.
- Loysell, *Journal de Medicine de Bruxelles*, Aug., 1884, results of extensive experiments with pure gas.
- Dr. Holstein had an important communication in the *Gazette Medicale de Paris*, the date of which I cannot recall.
- Dr. J. E. Purdon, surgeon in the English army at Calcutta, published in 1870 a work on cholera, etc., in which oxygen was elaborately treated.
- Oxygen in Hydrophobia. *N. E. Medical Gazette*, March, 1877, p. 142.
- Oxygen and Ozone. A treatise by Waldman, one of the chief physicians of Berlin.
- See *Philadelphia Medical Bulletin*, March and April, 1866, for articles by Dr. Vanderbeek.
- Compound Oxygen: Its History and Secret of Manufacture. M. S. Purdy, M. D., Corning, N. Y., in *Health Record*, Aug., 1886.

Hydrogen Peroxide is an article that is assuming importance, because it is a liquid oxygen, and admirably adapted for use as a "home treatment" adjunct—in fact, the only scientific one there is. The literature regarding it is growing from the nest-eggs occasionally found in works on chemistry. Chemist Hensel has published a small work in German, and a surgeon and chemist in New York have translated it. Chemist Clifford Mitchell, Chicago, had interesting articles on it. At the 1885 meeting of the Indiana Institute of Homœopathy I read a paper on Hydrogen Peroxide, and it was published in the *Chicago Medical Era*, July, 1885. At the request of the publishers and others, it was recently rewritten, and was again published in the *Era*, last month (April, 1886). The mode of using it was detailed in the lat-

ter article, and a number of papers referring to the product were mentioned which will not be mentioned in the following list.

The best hydrogen peroxide is the Charles Marchand article patented 1883, obtainable of Ernest Drevet, 10 West 4th street, New York, at about sixty cents a pound bottle. It requires no neutralizing before use.

Hydrogen Peroxide in Ophthalmic Practice. Laudolt, London Medical Record, March, 1883.

Peroxide of Hydrogen in Diphtheria. R. J. Nunn, Savannah, N. Y. Medical Record, 1884.

Hydrogen Dioxide. Dr. S. S. Wallian, N. Y. State Medical Society, Feb., 1885.

Peroxide of Hydrogen. Dr. W. A. Dayton, N. Y. Med. Journal, April 25, 1885.

Hydrogen Peroxide. C. E. Shelly, Practitioner, March, 1884.

Hydrogen Peroxide. Dr. W. W. Blackman, Brooklyn, N. Y., in N. A. Journal of Homœopathy, July, 1886. (An excellent article, but exasperatingly scanty in regard to quotation marks).

This paper, long as it is, would be incomplete without reference to Ozone, another form of oxygen, produced during the electrolysis of water, or when a piece of phosphorus lies half immersed in water, or by slightly moistening a mixture of equal parts of peroxide of manganese, permanganate of potassium, and oxalic acid, or, in a small way (according to Cohn) placing a bouquet of flowers in peroxide of hydrogen instead of water; and in other ways. It is the greatest purifying agent known, and is destined to assume a remedial place in the economics of the world. For want of time and space, for further particulars I refer you to the following papers :

Ozone by a New Process. Popular Science Monthly, Feb., 1873, p. 507.

Method of Producing Ozone in Large Quantities. Dr. Andrew H. Smith, N. Y. Medical Record, Sept. 5, 1885, p. 256 (illustrated).

Ozone. Dr. E. G. Cook, Chicago, U. S. Medical Investigator, Oct. 1, 1887, p. 370-376. Read at Illinois Homœopathic Congress, and generating and dispensing apparatus shown. Surgeon Geo. A. Hall highly commended it, speaking from hospital experience with apparatus. Therapeutic Value of Ozone, by the same writer, supplemental after two years' use, appeared in the same journal, Dec. 1, 1878.

Ozone and Atmospheric Electricity, and their Relation to Health and Disease. Dr. Geo. M. Beard, Popular Science Monthly, Feb., 1874, p. 456-469.

Ozone; Its Effect Upon the Health of Human Beings, Dr. T. S. Verdi, Washington Board of Health reports, and in U. S. Med. Investigator, May 1, 1875. (4 pages).

Ozone as a Disinfectant. W. W. Simons, Signal Corps, U. S. A. Read before Congressional Homœopathic Yellow Fever Commission, New Orleans, and published in *Hahnemannian Monthly*, March, 1879.
 Ozone in Disease. Dr. Chas. E. Barney, U. S. Med. Investigator, Feb. 1, 1878, p. 112-114.
 Ozone. Dr. J. P. Geppert, Cincinnati, U. S. Med. Investigator, March 1, 1879, p. 172-173.
 Ozone and its Merits. Dr. G. H. Merkel, Boston, pamphlet, reprinted from 1883 Transactions American Eclectic Association.

What are called Ozone baths are a specialty in Eastbourne, England. The bath is filled with long green seaweed, steeped in boiling water for an hour before use. The bathers remain in about twenty minutes, and the bath is thought very invigorating.

"Ozonine," a liquid ozone, was brought forward by Prof. Beck, discussed at the Biological Society of Paris, and described in the *Répertoire de Pharmacy et Journal de Chimie Médicale*, 1, 1885. I have not used it.

"Ozone Water," which I here display, produced under the supervision of Chemist G. H. Merkel, at Boston, is one of the newer candidates for favor. It is distilled water charged with ozone. I have found it useful in catarrh. It is easy of use, being simply put in an inhaler, plain and unwarmed. The Chemical Ozone Co., 120 Purchase street, Boston, will furnish all information regarding it and ozone in general.

Those interested in a line of ozonized remedies should send for a copy of the *Journal of Progressive Medicine*, edited by Dr. John Buchanan, published by R. R. Russell, 77 Greenwich avenue, New York, in which they are well described.

[The Institute gave the author a vote of thanks for the paper, and in the discussion that followed Dr. J. T. Boyd spoke of his favorable experience with a line of treatment similar to the one outlined by Dr. Clark, and Dr. Runnels, who regretted that he had not heard the paper read, except the portion referring to hydrogen peroxide, desired to indorse that article very highly, as with it he had been able in several well marked instances to arrest cases of consumption in their incipency.]

Important Notice

TO THE

MEDICAL PROFESSION.

Peroxide of Hydrogen must be used intelligently. It is to be feared that it will be condemned, as it has been already, because of failures from the use of impure and improperly neutralized preparations.

If properly diluted, and if pure, it is as bland as water, and has nothing caustic irritating or poisonous about it.

Ch. Marchand's Peroxide of Hydrogen
IS WARRANTED TO BE GENUINE AND
RELIABLE in every respect.